

REMARKS

Claim 16 has been amended by incorporating therein the limitations of Claim 40 and by correcting two errors in the spelling of "particulate." Thus, Applicant's Claim 16 now recites as a limitation the size of the nucleation mode particles, whose number in the emissions from a diesel engine is reduced by the practice of Applicant's claimed method. In addition, Claims 20, 21, 27-32, 40, 45-51 and 55-58 have been canceled. Claims 16, 19, 25, 26, 33-39, 41, and 52-54 remain pending.

Thus, these amendments raise no new issues and require no additional search.

A critical element of Applicant's claims is that it is a method for reducing the number of nucleation mode particle having diameters in the range of from 1 nm up to 30 nm inclusive. Applicant has described the special problem presented by such nucleation mode particles in the emissions from diesel engines in her specification on page 2, lines 7-14. Although larger or accumulation mode particles make up the majority of the mass of particulate emissions, and nucleation mode particles make up only a relatively low portion of the mass of particulate emissions, the nucleation mode particles make a significant contribution to the total number of particulates emitted. Therefore, it is highly desirable to reduce the number of such nucleation mode particles in the emissions from diesel engines.

It is respectfully submitted that this limitation should not be overlooked in determining the patentability of Applicant's claims.

All limitations in Applicant's claims that distinguish over the prior art must be considered and cannot be ignored. In re Boe et al., 184 U.S.P.Q. 38 (C.C.P.A. 1974). In determining whether the subject matter as a whole is obvious all evidence bearing on the subject must be considered, including all differences between the subject

matter sought to be patented and the prior art. In re Wiggins, 158 U.S.P.Q. 199 (C.C.P.A. 1968); Palmer v. U.S. 156 U.S.P.Q. 689 (Ct. Cls. 1968). In re Khelghatian, 150 U.S.P.Q. 661 (C.C.P.A. 1966). In re Krazinski et al.; 146 U.S.P.Q. 25 (C.C.P.A. 1965); and In re Rinehart, 189 U.S.P.Q. 143 (C.C.P.A. 1976).

Applicant's claims also employ the term "low sulfur," but because that term is merely a relative term, Applicant's claims go further and spell out precisely what sulfur concentration is meant by "low sulfur." In particular, a "low sulfur" diesel fuel has a low sulfur content of below 50 ppm by weight in Applicant's Claims 16, 19, 33-39, 41 and 52-54, below 20 ppm by weight in Claim 25, and up to 10 ppm by weight in Claim 26. A "low sulfur" lubricating oil has a sulfur content of less than 0.4% by weight in Claims 16, 19, 25, 26, 36-39, 41 and 52-54, less than 0.3% by weight in Claim 33, less than 0.2% by weight in Claim 34, and less than 0.15% by weight in Claim 35.

Thus, a diesel fuel that has a sulfur content of 50 ppm by weight or more is not a "low sulfur" diesel fuel in Applicant's claimed invention, even if others may regard such a diesel fuel as being a low sulfur diesel fuel. Similarly a lubricating oil that has a sulfur content of 0.4% by weight or more is not a "low sulfur" lubricating oil in any of Applicant's claims, even if others may regard such a lubricating oil as being a low sulfur lubricating oil.

The criticality of the use of a low sulfur (that is, less than 50 ppm of sulfur by weight) diesel fuel with a low sulfur (that is, 0.14 weight % of sulfur) lubricating oil in Applicant's claimed method is illustrated very clearly in the Examples on pages 5-7 and in Figures 1 and 2 in Applicant's specification.

Figure 1 indicates the mass of particles in the emissions, while Figure 2 indicates the number of particles in the emissions. In Figures 1 and 2, the total

particulate emission is represented by the sum or combination of the open bars and shaded bars beneath the open bars. The shaded bars represent the aggregation of particulates having diameters of 7-320 nm, while the open bars represent the aggregation of particulates having diameters greater than 3 nm. Thus, the open bars are a measure of the total particulate count which includes both the nucleation mode particles and the relatively larger particles, while the shaded bars are a measure of only the relatively larger particles. Therefore, as stated in lines 21-23 on page 6 of Applicant's specification, the difference between the open bars and the shaded bars represents the aggregation of nucleation mode particles.

Figure 2 illustrates graphically that when a catalytic particulate trap (CRT) was not used, the total particulate emission was relatively large.

When a catalytic particulate trap (CRT) was employed and when either (a) a combination of a low sulfur (10 ppm by weight of sulfur) diesel (LSF in Figures 1 and 2) fuel and a high sulfur (0.75 percent by weight of sulfur) lubricating oil (HSL) or (b) a combination of a high sulfur (50 ppm by weight of sulfur) diesel fuel (HSF) and a high sulfur (0.75 weight percent of sulfur) lubricating oil (HSL) was employed along with the catalytic particulate trap, the emission of relatively large particles having mean diameters greater than 7 mm was reduced as indicated by the reduced shaded bar. However, there was essentially no reduction in the number of nucleation mode particles in the emissions, and in fact the number of nucleation mode particles in the emissions increased when the combination of high sulfur diesel fuel (HSF) and high sulfur lubricating oil (HSL) was employed, as indicated by the increased open bar.

By contrast, when (c) the combination of the low sulfur (10 ppm by weight of sulfur) diesel fuel (LSF) and a low sulfur (0.14 weight percent of sulfur) lubricating oil (LSL) was employed with the catalytic particulate trap, not only were the total

particulate emissions and the emissions of particles having mean diameters greater than 7 nm reduced, as indicated by the almost completely eliminated shaded bar; but also the number of nucleation mode particles in the emissions was reduced, as indicated by the completely eliminated open bar. Further, in this case, the reduction of total particulate emissions was substantially greater than any such reduction expected based on the reduction in the total sulfur level of that combination of low sulfur diesel fuel (LSF) and low sulfur lubricating oil (LSL).

The results in Figure 1 demonstrate the same trend for the total mass of particles being emitted.

Chamberlin et al. discloses combinations of a fuel and a lubricating oil that have required “low sulfur” concentration levels that are drastically different (1) from the low sulfur content of the diesel fuel of only up to less than 50 ppm by weight in Applicant’s Claims 16, 19, 33-39, 41 and 52-54, up to less than 20 ppm by weight in Applicant’s Claim 25, and up to 10 ppm by weight in Applicant’s Claim 26, and (2) from the low sulfur content of the lubricating oil of as much as less than 0.4 weight % in Applicant’s Claims 16, 19, 25, 26, 36-39, 41 and 52-54, less than 0.3 weight % in Claim 34, and less than 0.15 weight percent in Claim 35.

By contrast to the “low sulfur” content of lubricating oil in Applicant’s claims, Chamberlin et al. requires that the lubricating oil that it discloses must have between 5 and 250 ppm, which is equivalent to between 0.0005 and 0.0250 percent. Furthermore, Chamberlin et al. discloses in column 4, lines 54-56 that it is “critical” that the sulfur content of the lubricating oil must be in this range.

It would be improper to ignore this teaching of criticality in Chamberlin et al. or to modify this disclosure in Chamberlin et al. in a manner that would be contrary to

its own teaching or render it unfit for its intended purpose. In re Ratti; 123 U.S.P.Q. 349 (C.C.P.A. 1959); Ex parte Rosenfeld, 130 U.S.P.Q. 113 (P.T.O. Bd. App. 1961).

However, the “low sulfur” lubricating oil recited in Applicant’s claims can contain up to 0.15 weight percent of sulfur in Applicant’s Claim 35, up to 0.2 weight percent in Applicant’s Claim 34, up to 0.3 weight percent in Applicant’s Claim 33, and finally even up to 0.4 weight percent in Applicant’s Claims 16, 19, 25, 26, 36-39, 41 and 52-54. Thus, the “low sulfur” lubricating oil recited in Applicant’s claims can have a sulfur content which can be as much as 16 times larger than the “critical” upper limit of the sulfur content of the lubricating oil of Chamberlin et al. In Applicant’s Examples on pages 5-7 in Applicant’s specification, the sulfur content of the LSL or low sulfur lubricating oil was 0.14 weight percent, which is 5.6 times larger than the critical upper limit of the sulfur content of the lubricating oil of Chamberlin et al.

Similarly Chamberlin et al. discloses in column 16, lines 26-31 that the sulfur content of its “low sulfur” gasoline can be up to about 300 ppm , or in various embodiments, up to about 150 ppm, up to about 100 ppm, up to about 50 ppm, or up to about 25 ppm. In column 16, lines 33 and 41-43, Chamberlin et al. discloses that “any diesel fuel” can be employed and that a suitable diesel fuel has up to about 0.05 weight percent (that is, up to about 500 ppm by weight) of sulfur.

However, gasoline cannot be employed as the fuel in Applicant’s claimed process, and the “low sulfur” diesel fuel recited in Applicant’s claims can only contain only up to less than 50 ppm by weight in Applicant’s Claims 16, 19, 33-39, 41 and 52-54, up to less than 20 ppm by weight in Applicant’s Claim 25, and up to 10 ppm by weight in Applicant’s Claim 26.

Thus, Chamberlin et al. discloses that

(1) its lubricating oil has a critical sulfur content which must be in the range of 5 to 250 ppm of sulfur, which is much lower than the sulfur content of the lubricating oil recited in Applicant's claims of up to less than 0.4 weight percent, up to 0.3 weight percent, up to less than 0.2 weight percent, or even up to less than 0.15 weight percent of sulfur and also much lower than the sulfur content of 0.14 weight percent of the low sulfur lubricating oil employed in Applicant's examples; and

(2) its fuel can be either (a) a gasoline having a sulfur content of up to about 300 ppm, up to about 150 ppm, up to about 100 ppm, up to about 50 ppm, or up to about 25 ppm of sulfur, or (b) "any" diesel fuel including a diesel fuel having a sulfur content of 0.05 weight percent or about 500 ppm of sulfur, which is much higher than the maximum sulfur content of up to less than 50 ppm for the low sulfur diesel fuel in Applicant's claims, and the sulfur content of 10 ppm for the low sulfur diesel fuel in Applicant's examples.

Thus, Chamberlin et al. discloses a combination of (1) a critical sulfur concentration range for its lubricating oil which is much lower than the sulfur content which Applicant's low sulfur lubricating oil may have, and (2) a broad range (up to 300 ppm) of sulfur contents for its gasoline which includes a large range (50-300 ppm) of sulfur contents, and a sulfur content (500 ppm) of a diesel fuel, which are completely outside the range of sulfur contents for Applicant's low sulfur diesel fuel and which Applicant's examples clearly demonstrate would not produce acceptable results if employed in Applicant's claimed method.

Furthermore, Chamberlin et al. is directed to producing an entirely different result than the result produced by Applicant's claimed method. The method disclosed by Chamberlin et al. has the following as its purposes: (a) to extend the time intervals between oil changes, (b) to reduce NO_x levels in exhaust gases and (3) to avoid

damaging the exhaust gas aftertreatment device. The method disclosed in Chamberlin et al. is not intended to, and does not, reduce the number of nucleation mode particles in the emissions from diesel engines.

The exhaust gas aftertreatment device as identified by 18 in Figure 1 of Chamberlin et al. and is described in column 15, lines 28-30 only as an “exhaust gas aftertreatment device 18 (e.g., catalytic converter, particulate trap, catalyzed trap, and the like).” The same description appears in column 3, lines 25-30. Thus, Chamberlin et al. mentions a particulate trap as merely one of a number of the possible exhaust gas after treatment devices. The method disclosed in Chamberlin et al. functions only to avoid damaging an exhaust gas aftertreatment device. Such method is not disclosed as a method for reducing the number of nucleation mode particles in the emissions from a diesel engine, or as a method to improve the ability of a particulate trap in reducing the number of nucleation mode particles in the emissions from a diesel engine. Furthermore, the method of Chamberlin et al. would not inherently result in the reduction of the number of nucleation mode particles in the emissions from a diesel engine. The single sulfur content (500 ppm) of the diesel fuel disclosed in Chamberlin et al. and the vast majority (50-300 ppm) of the range (up to 300 ppm) of sulfur contents of gasoline disclosed in Chamberlin et al. are much too high to be employed in Applicant’s claimed method and therefore to result in a reduction in particulate emission. Applicant’s examples prove that the reduction of the number of nucleation mode particles in the emissions from a diesel engine would not inherently result from the practice of the method of Chamberlin et al.

Chamberlin et al. contains no mention or even a suggestion of a method for the reduction of particulate emissions. Most importantly Chamberlin et al. contains

no appreciation whatsoever of the reduction of the number of nucleation mode particles in the emissions from diesel fuels.

The Examiner has cited Alcorn et al. as a secondary reference to provide the disclosures that are not found in Chamberlin et al. Alcorn et al. discloses a particulate trap through of rotated portion of which a separate regenerating fluid is directed in order to remove the particles collected on such portion of the trap and thereby to continuously regenerate the trap. This is disclosed in column 2, lines 41-44 and column 3, lines 60-64. First, Applicant is not claiming to have invented particulate traps. Furthermore, the catalyzed particulate trap employed in Applicant's claimed process is a continuously regeneration trap (CRT™), whose operation is described in Applicant's specification on page 3, lines 3-24. In a CRT™, the trapped particulates are burned off from the filter with oxidation products that are produced by the reaction between the catalyst in the trays and components of the exhaust gas. There is no separate regenerating fluid, and the CRT™ is not rotated. Furthermore, Alcorn et al. never even mentions nucleation mode particles.

Thus, none of the deficiencies discussed above of the disclosure of Chamberlin et al. regarding the sulfur contents of the diesel fuel and lubricating oil and regarding reduction of the number of nucleation mode particles in the emissions from a diesel engine are cured by the disclosure of Alcorn et al. Thus, even if the disclosures of Chamberlin et al. and Alcorn et al. were combined as the Examiner proposes, the resulting combination would not provide adequate support for a rejection of any of Applicant's claims under 35 U.S.C. 103.

The Examiner also cited the combination of Chamberlin et al. and Alcorn et al. with Papay et al. as another secondary reference. Papay et al. discloses numerous lubricating oil compositions, many of which are sulfur-compositions. For example,

Papay et al. discloses oil-soluble overbased salts of alkali or alkaline earth metals with sulfuric acids in column 8, lines 28-32; and discloses overbased salts of numerous sulfurized substances in column 9, lines 8-10, and 23. Furthermore, Papay et al. discloses in column 13, lines 42-47 that overbased magnesium and/or calcium sulfonates are the preferred metal detergents. Moreover, nowhere in the seventy columns of the specification of Papay et al. is there even a mention of a "low sulfur" lubricating oil composition or fuel. Papay et al. discloses no appreciation of the need or desirability of a low sulfur lubrication oil or diesel fuel. Also Papay et al. contains no mention whatsoever of either nucleation mode particles or the reduction of the number of nucleation mode particles in the emissions from a diesel fuel.

Thus, none of the deficiencies discussed above of the disclosure of Chamberlin et al. Regarding the sulfur contents of the diesel fuel and lubricating oil and regarding the reduction of the number of nucleation mode particles in the emission from a diesel engine are cured by the disclosure of Papay et al. Thus, the Examiner proposed combination of the disclosures of Chamberlin et al., Alcorn et al. and Papay et al. does not provide sufficient support for a rejection for any of Applicant's claims under 35 U.S.C. 103.

As support for two other rejections of Applicant's claims under 35 U.S.C. 103, the Examiner cited Chamberlin et al. in view of Cooper et al. and Twigg et al. as secondary references. Cooper et al. discloses a process for combusting the particulate from diesel exhaust gas which has been deposited on a filter when the exhaust gas is passed through the filter. However, Cooper et al. contains no mention whatsoever of nucleation mode particles or of the sulfur contents of the diesel fuel and of the lubricating oil in it. In fact, the examples in Cooper et al. were performed using a synthetic exhaust gas that was prepared from pure component compressed gases, as

disclosed in column 4, lines 21-27 and 53-64. Actual diesel fuels and actual lubricating oils were never employed or described in Cooper et al. Thus, even if Chamberlin et al. and Cooper et al. were combined as proposed by the Examiner, the deficiencies discussed above in the disclosure of Chamberlin et al. regarding the sulfur contents of the diesel fuel and the lubricating oil and the reduction of the number of nucleation mode particles from the emissions from a diesel engine cannot be provided or rectified by the disclosure of Cooper et al.

Finally, as indicated in column 1, lines 25-39, Twigg et al. discloses a modification of the system disclosed in Cooper et al. Twigg et al. states in column 2, lines 46-49 the deleterious effect of "high sulfur contents, e.g. above 500 ppm." From this mention of "500 ppm" as a high sulfur content, one of ordinary skill in the art could only possibly conclude a sulfur content below 500 ppm is a low sulfur content. No other interpretation is reasonable. Twigg goes on to state in column 2, lines 49-50 that it is desirable to use low sulfur fuel. Thus, Twigg et al. teaches one of ordinary skills in the art to use a diesel fuel having a sulfur content below 500 ppm.

Then in column 4, lines 13-21, Twigg et al. states that the tests whose results are shown in Figure 4 were performed, in one case, with diesel fuel containing 500 ppm of sulfur and, in the other case, with a fuel containing absolutely no sulfur. Twigg et al. concludes that a greater improvement was obtained using a sulfur-free diesel fuel.

However, as indicated in column 3, lines 29-30, Twigg et al. describes Figure 4 as a chart showing the weights of soot collected on a second catalyst within the trap. Thus, the results in Figure 4 and the entire disclosure of Twigg et al. pertain to the mass or weight of particulates collected on a second catalyst within the trap. Such results give no indication whatsoever of the number of (not the mass) of particulates

that pass out of the particulate trap and, most importantly of the number of nucleation mode particulates that pass out of the trap, or the reduction of the number (not the mass) of the nucleation mode particulates that pass out of the trap.

From Figure 4 in Twigg et al., the mass of particulates that are collected on the second catalyst within the trap is an indication of the reduction of the mass of total particulates that passes out of the trap. However, it does not disclose or even suggest to one of ordinary skill in the art anything whatsoever regarding the reduction of the number of nucleation mode particles having diameters in the range of from 1 nm up to 30 nm inclusive that pass out of the trap.

Applicant's examples involve measurements of the number of nucleation mode particulates that pass out of and downstream of the catalyzed particulate trap CRT.TM By contrast, the test whose results are shown in Figure 4 of Twigg et al. measures the mass of the particles that is retained within the catalyzed particulate trap. Consequently, from Twigg et al., one of ordinary skill in the art would not be able to learn anything about (a) the number of nucleation mode particles having diameters in the range of from 1 nm to 30 nm that would pass downstream from the trap, or (b) the reduction of the number of nucleation mode particles having diameters in the range of from 1 nm up to 30 nm inclusive that pass out of the trap.

A prior art rejection cannot be based on inherency unless the inherency is certain. However, recognizing that the Examiner can require the Applicant to prove - and in anticipation of a possible requirement by the Examiner -- that a reduction of the number of nucleation mode particulates having diameters in the range of from 1 nm to 30 nm inclusive in the emissions from a diesel engine would not inherently occur in the course of the practice of the method disclosed in Twigg et al., the results of Applicant's examples that are presented in Applicant's Figure 2 demonstrate that

there is no such inherency. The results for the combinations of (a) the low sulfur fuel (LSF) with the high sulfur oil (HSL) and (b) the high sulfur fuel (HSF) with the high sulfur lubricant oil (HSL) indicate that even though there was a reduction in the mass of total particulates that passed out of and downstream of the trap for each of such combinations (a) and (b), there was no reduction in the number of nucleation mode particulates having diameters in the range of from 1 nm to 30 nm that passed out of and downstream of the trap for such combination (a), and there was even a very substantial increase in the number of nucleation mode particulates having diameters in the range of from 1 nm to 30 nm that passed out of the trap for such combination (b).

Thus, Applicant's own examples demonstrate that even when there is a reduction in the mass of total particulates in the emissions from a diesel engine, it is definitely not inherently true that there will also be a reduction in the number of nucleation mode particulates having diameters in the range of from 1 nm up to 30 nm inclusive in the emissions from a diesel engine.

Not a single one of the five references cited by the Examiner discloses any recognition of the existence or number of nucleation mode particles having diameters in the range of 1 nm to 30 nm in the emissions from diesel engines. Not one of these references addresses the reduction of, or even the desirability of the reduction of the number of these nucleation mode particles in the emissions from diesel engines.

Nevertheless, the limitations in Applicant's claims pertaining to the reduction in the number of nucleation mode particles having diameters in the range of from 1 nm to 30 nm must be considered and cannot be ignored. In re Boe et al., 184 U.S.P.Q. 38 (C.C.P.A. 1974). In determining whether the subject matter as a whole is obvious all evidence bearing on the subject must be considered, including all differences between the subject matter sought to be patented and the prior art. In re

Wiggins, 158 U.S.P.Q. 199 (C.C.P.A. 1968); Palmer v. U.S. 156 U.S.P.Q. 689 (Ct. Cls. 1968). In re Khelghatian, 150 U.S.P.Q. 661 (C.C.P.A. 1966). In re Krazinski et al.; 146 U.S.P.Q. 25 (C.C.P.A. 1965); and In re Rinehart, 189 U.S.P.Q. 143 (C.C.P.A. 1976).

For these reasons, the Examiner's proposed combination of the disclosures of Chamberlin et al., Cooper et al., and Twigg et al. does not support a rejection of any of Applicant's claims under 35 U.S.C.103.

In view of the above amendments and remarks, Applicant respectfully submits that her Claims 16, 19, 25, 26, 33-39, 41 and 52-54 are in condition for allowance, and reconsideration and allowance thereof are respectfully requested.

Respectfully submitted,

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